AGS EXPERIMENTERS GUIDE

June 22, 1976

In the AGS experimental areas potentialities naturally exist for serious, even fatal accidents. There are latent hazards posed by heavy mechanical equipment; electrical systems; corrosive, toxic and flammable gases; explosion; fire; and radiation. Whereas we have maintained an excellent safety record in such a complex environment without undue inconvenience to our staff and users, we can only assure the continuance of this safety record by having the active cooperation of each individual with access to the experimental areas. We urge each such person to familiarize himself and the other members of his group with our safety regulations and procedures and with the Laboratory Emergency Plan. Willful or flagrantly negligent disregard of these safety practices may result in termination of our services to the experiment.

R. Ronald Rau
Associate Director for
High Energy Physics

AGS EXPERIMETERS GUIDE

SECTION III

SAFETY INFORMATION

AGS SAFETY PRACTICES

A research facility such as the AGS contains many potential hazards, some of which may be unfamiliar to the unseasoned experimenter. High intensity radiation, large power usage, the presence of explosive gases and liquids, and a continual heavy construction schedule present conditions that require more than the normal regard toward safety. For this reason, formal safety procedures have been established. They are contained in the BNL Emergency Plan Manual, the BNL Safety Manual, and Accelerator Department Safety Procedures. The Synchrotron Health Physics Staff and the Experimental Operations Group also have Operating Procedure Manuals and maintain a continual watch of the experimental areas.

The user must also play his part in contributing to the safe, successful fulfillment of the experiment program. His familiarity and compliance with AGS safety procedures is required. If any items are unclear or questions left unanswered, the experimenter should discuss them with his liaison engineer, who should be the first contact with any problem, safety or otherwise.

Some of the important safety requirements are:

Orientation - All personnel (including experimenters) who will be at BNL for more than five days will receive a Safety Orientation. All experimenter groups utilizing the AGS facility shall schedule the Orientation through the Health Physics Group.

Review of Apparatus - Experimental apparatus utilizing flammable, toxic, or other potentially hazardous materials must be reviewed prior to use in the experimental area. In some cases, the equipment design must be reviewed prior to construction. All reviews are arranged through the Liaison Engineer.

Cryogenic Safety - Cryogenic safety is a primary concern in the experimental areas at AGS. Each use must be reviewed by the Liaison Engineer and may require review by the Cryogenic Safety Committee. To protect against an accidental release of the liquid or gas, "local tents" are built around equipment; special local and building exhaust systems are provided as well as piped systems to carry off normal and emergency releases.

Laser Use - All lasers must be registered with the BNL Safety Services.

BNL Fire Alarm - Most BNL buildings are provided with a system of automatic fire detection, and local fire alarm boxes which are connected to the BNL Fire House. The fire alarm is a continuous ringing bell.

Evaucation Procedures - A klaxon (pulsating siren) and/or the intermittent ringing of the fire alarm bells is the signal to evacuate the experimental buildings because of some emergency. All personnel must immediately evacuate and go to an assembly area which is not in the line of sight from the evacuated building. The evacuation signal actuators are located near the building exits and may be actuated by anyone discovering an emergency. The Local Emergency Plan (Section III-22) goes into detail on evacuation alarms, procedures, assembly areas, etc.

Injuries - BNL regulations require that all injuries to personnel (including experimenters) must be reported to the BNL Clinic. Emergency treatment is available there on a 24-hour, 7-day basis.

Experimenters should familiarize themselves with certain detailed safety requirements, the most important of which comprise this section of the Guide.

FILM BADGE AND DOSIMETER REQUIREMENTS

The AGS magnet enclosure and its environs, plus Linac and all the AGS experimental areas, are designated and posted as radiation areas as defined in the BNL Safety Manual.

Within these areas all persons are required by Laboratory policy to wear film badges at all times. However, since accelerators operate on an intermittent schedule, the true status of the radiation areas varies with the on-off cycles of the machine, becoming radiation areas the moment the machine is on and remaining so for some period of time after shutdown due to residual activity levels. Dosimeters may be required in certain areas of the AGS complex. Dosimeters may be obtained at the Health Physics Office in Building 911 or in the East Experimental Building Service Bay.

The outside entrances to these radiation areas are defined by standard radiation signs bearing the words "Radiation Area-Film Badge Required".

The primary responsibility for complying with this procedure rests with the individual concerned. Supervisors and Experimental Group Leaders are further responsible for securing compliance by all members of their groups.

Film badges should be returned to the rack at the end of the work day -- definitely not left in a radiation area while not being worn.

The practice of wearing numerous visitor badges must be discouraged, since the assigned exposure recorded can be underestimated by standard personnel monitoring procedure, the error being proportional to the number of badges processed. Visitors for a period less than three months should use a visitors film badge for a two week period and then turn it in in exchange for a new visitor's badge. A visitor for a period longer than three months will be issued a film badge. It is the responsibility of the Department members to provide their visitors with a film badge (and dosimeter if necessary) prior to entering a radiation area. Similarly, members of an experimental group must ensure that their visitors are properly equipped with film badges (and dosimeters if necessary). The badge should be worn as high as possible, as normal beam height is 60" in the Target Building and 78" in the East Experimental Areas.

Film badges are collected on alternate Wednesdays at the AGS. It is important that all badges be returned to racks when not being worn. There is a color-coding mark on the film badge. If the color is not the same as the color indicated at the film badge boards, the film badge is overdue for processing.

The Accelerator Department watch personnel and the Health Physics Group have the authority to refuse admittance to those persons not wearing film badges or dosimeters in areas where they are required.

TARGET HANDLING AND STORAGE PROCEDURES

For the purpose of this procedure, the word "target" is used to indicate any object which has been intentionally or unintentionally bombarded by a high energy particle beam either inside the vacuum chamber or in an external particle beam. This includes:

1. Any object placed in the vacuum chamber or in external particle beams to function specifically as a target.

2. Any device within the machine or any part of the machine, e.g., flags, viewing screens, vacuum chamber walls, etc., or any device bombarded by primary external beams, e.g., bending or focusing magnets, beam pipes, etc. The handling of targets can present a variety of radiation hazards which may be classified into two groups. These are:

   (a) Significant external radiation levels from the target due to induced radioactivity.

   (b) Contamination due to induced radioactivity which may be transferred to the skin or clothing and spread about the AGS complex or possibly be ingested or inhaled.

Before handling or working with or around any target, the senior shift Health Physics man will be consulted to recommend safe procedures. Any radioactive device which must be left exposed must be clearly labeled to indicate tolerable working limits, if necessary. The Health Physics representative can be reached at Ext. 4654 or 4660.

All personnel working with "hot" targets (> 200 mr/hr at 6-in.) will wear safety glasses to help minimize β-ray exposure to the eyes. Persons actually handling a target will wear gloves and will wash their hands thoroughly after the work to avoid spreading or ingesting any contaminants that might possible be on their person.

No machining, filing, welding, drilling, grinding, etc. is to be performed on targets without consultation and approval of one of the AGS Health Physics group supervisors. In general, targets having any more than a trace ($\sim$ 2 times background) of residual activity will not be machined at the AGS shop, but rather will be worked on at the BNL Hot Shop. This is to prevent contamination of the equipment and machinery in our shop which is used in the machining of devices and equipment requiring very low background, e.g. monitoring devices, bubble chamber equipment, etc. The Target Group maintains a Hot Laboratory for limited work on radioactive targets. The AGS complex is in general a "clean area" and should be considered as such by persons bringing equipment into the complex from other areas of the Laboratory. Very careful internal control is maintained over machine produced contamination.

Internal machine targets will be stored in an area provided for that purpose. The Target Group and the Main Control Room operators will maintain keys to this facility. Detailed instructions for operation of the facility will be posted in the area.

Other general or bulky items will be stored by the direction of a Health Physics Supervisor in designated areas. Under no circumstances are targets to be allowed to return to general materials stock or to lie about unmarked.

CONTROL OF CHECK SOURCES

Although check sources are usually small in size and of low intensity, they do present certain problems owing to the fact that they can be and are easily lost. A lost source may result in an unnecessary radiation exposure to persons ignorant of its presence. In addition, these sources may be mechanically damaged by shielding blocks or other heavy equipment, thus contaminating equipment and areas in which very low background is desirable and in some cases necessary.

In view of the above, the Safety and Environmental Protection (SEP) representative will maintain custodial control over all radioactive materials in the AGS complex. No radioactive materials will be brought into or removed from the complex without obtaining a form signed by M. Plotkin and initialled by the SEP representative or his designate. The Health Physics Group of the SEP may be reached at Extensions 4654 and 4660. In general, approval will not be granted for the more hazardous types of sources, i.e., radium, polonium, plutonium, etc., unless the specific radiation spectrum from the source is necessary for the experimental work planned.

To minimize the number and types of sources brought into the complex, the Department has several sizes of check sources available to all groups on a short term loan basis. Information on the available sources may be obtained from the Health Physics Group. Others will be obtained in the future if the need arises.

All sources, when not actually in use, will be kept in the radioactive materials locker located in the East Experimental Building. Sources may be obtained from this locker by contacting the Health Physics Group and signing for the source. Sources will be kept in a shielded container while on the experimental floor except when being used to check counting equipment. Shielding should be adequate to reduce radiation levels to at least 7.5 mr/hr at 2 ft.

The check sources belonging to the Department must not be removed from the AGS complex, and no source should be taken to the non-radiation areas of the complex at any time.

All sources must be tagged with the standard BNL isotope tag.

RADIATION AREA WASTE DISPOSAL

All waste material in the Main Magnet Enclosure and associated high radiation areas is to be placed in waste disposal containers marked for radioactive waste by a Health Physics label. These containers are located at various points in the ring and other areas.

The handling of radioactive waste is a costly and time-consuming operation. Therefore, it is important that these cans be used ONLY for radioactive waste or waste removed from radioactive areas where there is a possibility of residual radiation or contamination. If there is any question as to the residual radiation level of waste material, the Health Physics Group should be called to check it.

HEALTH PHYSICS TAGS

Any material or equipment that is removed from the Main Magnet Enclosure or associated with high radiation areas, must have a Health Physics label or tape on it indicating that the item was in the radiation area and that there is a possibility of residual radiation or contamination.

Any material that has this label or tape must be checked by Health Physics before it is moved into a clean area for storage, general use, or machining.

Health Physics will check these items and will attach one of the following two types of tags:

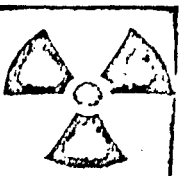
1. A small white tag which will indicate that there are no restrictions on handling, storage, machining or disposal. This tag must be removed when the item is returned to a radiation area.

2. A large yellow tag indicating that there is residual radiation or contamination present. In such a case, Health Physics must be consulted before handling, storage, machining or disposal.

The tags and tape are illustrated on the next page.

RADIOACTIVE
CHECK WITH
HEALTH PHYSICS
BEFORE HANDLING
OR DISPOSAL

RADIOACTIVE
CHECK WITH
HEALTH PHYSICS
BEFORE HANDLING
OR DISPOSAL



Health Physics Tape (yellow)

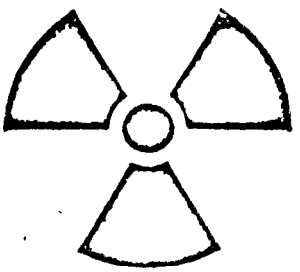
YELLOW TAG

TIME | DATE | LEVEL C/M MR/HR

ITEM:
REMOVED
FROM:
TIME: DATE:
OWNER:
SURVEYOR:
RADIATION LEVEL
CONTAMINATION: C/M
MR/HR
ACTIVATION C/M

WARNING

RADIATION



STORE ONLY IN HOT-LOCKER

DO NOT MACHINE

CONTACT HEALTH PHYSICS FOR DISPOSAL OF ITEM OR PARTS

REMARKS:

WHITE TAG

REMOVE TAG WHEN RETURNING ITEM TO RADIATION AREA

DATE:

SURVEYED BY:

THIS ITEM HAS BEEN CHECKED BY HEALTH PHYSICS

NO RESTRICTION ON HANDLING, STORAGE MACHINING OR DISPOSAL

CONTROL OF SHIELD OPENINGS

For the purpose of this procedure, the term "shielding change" will describe changes in shielding, collimator configuration, beam ports between primary beam areas and areas of possible personnel access. Since an unnecessary and perhaps serious radiation exposure can result from altering any of the above, the following procedures must be followed to minimize the possibility of this occurrence.

1. All shielding changes at the AGS shall have the prior approval of the Safety and Environmental Protection (SEP) representative (normally W.R. Casey) and the Liaison Engineer assigned to the experimental group requesting the change. Any proposed changes that could possibly affect other experiments must also have the approval of the Liaison Engineer of those experiments.

2. All shielding changes will be made only by the Experimental Area Operations Group after informing the duty Health Physics man.

3. Whenever possible, shielding changes will be performed when the machine is not operating. If it becomes necessary to make a shielding change when the machine is operating, the duty Health Physicist must be consulted prior to making the change.

4. It is the responsibility of the Liaison Engineer making the shielding change to notify the duty Health Physicist of the change so that proper warning signs and other precautions can be set up, if they are necessary.

5. Beam ports will be routinely closed except when needed for experimental purposes.

EXPERIMENTAL AREA PROVISIONS FOR SMOKING AND EATING

A wide variety of potential health hazards exist in the AGS Experimental Areas. These hazards include high voltages, overhead rigging, explosive gases and radiation. It is obvious that these areas require a high degree of alertness on the part of all persons present and therefore make it necessary to prohibit or limit the practice of smoking, eating and sleeping in certain areas.

Smoking is permitted anywhere in the Experimental Areas except where posted. All flammable fluid devices are posted as "No Smoking" areas at a distance no closer than 20 feet from the hazardous device. The EAO Watch Supervisor is responsible for designating and posting "No Smoking" areas and seeing that these areas are maintained.

An eating area with kitchen facilities is provided for use by all Laboratory personnel and experimenters. It is located in the Service Bay attached to the East Experimental Building. The room is provided with stove, sink, refrigerator, table and chairs. It is always accessible (except for short periods for housekeeping) and the user is only asked to keep it clean.

In the above eating area, vending machines are maintained and stocked daily with sandwiches, soups, pie, candy, ice cream and beverages such as coffee and soda. A change machine which accepts $1.00 bills is also available.

VISITORS TO AGS EXPERIMENTAL AND OPERATIONAL AREAS

A number of potential health hazards exist in the AGS Experimental and Operational Areas. Among them are high voltages, explosive gases, toxic chemicals, heavy rigging, complex machinery and radiation. There also exists the possibility of damage to delicate and accurately aligned apparatus necessary to the operation of the AGS or the experimental program. For these reasons, a policy of allowing visitors to the Experimental Areas must be governed by the following conditions:

1. A visitor is anyone not directly involved with the accelerator or the experimental program.

2. All visitors must be accompanied by a member of the Accelerator Department Staff, or a member of an Experimental Group.

3. All visitors must have the necessary personnel monitoring equipment when visiting a posted radiation area.

4. No one under the age of 18 or any pregnant women will be permitted in the experimental areas. This is primarily because children, infants and unborn infants are more sensitive to the damaging effects of radiation than are adults.

5. Visits to areas within the magnet enclosure must be accompanied by a member of the Accelerator Department or a Health Physics representative.

6. During periods when the machine is not running, the radiation hazard is lessened, but high remaining residual levels and increased construction type hazards necessitate that the above restrictions on visitors remain in effect.

It is the responsibility of every AGS Experimenter and Accelerator Department employee who has a visitor to be familiar with and comply with AGS safety practices and see that this procedure is followed. The Health Physics Group and the Experimental Operations Group are particularly charged with the responsibility of policing the Experimental Areas.

Relatives and guests should be encouraged to tour the Laboratory during the official visitors days or open house periods. Other group tours are conducted from time to time and arrangements may be made through the Director's Office.

CRYOGENIC SAFETY

Cryogenic liquids which have a high incidence of usage in the experimental areas are nitrogen, hydrogen, deuterium and helium. Some characteristics of these are as follows:

	Weight of Liquid Per Liter		Volume of Gas Produced NPT Per Liquid Liter		Heat of Vaporization per Liquid Liter		Boiling Point Approx. at 1 Atmosphere		
	Grams	Lbs	Liters	Cu.Ft.	Cal.	BTU	°C	°F	°K
Helium	125	0.27	700	26.7	500	1.99	-268.9	-452	4.2
Hydrogen	70	0.15	770	27.2	7600	30.2	-252.7	-422.9	20.4
Deuterium	168	0.37	940	33.2	12700	50.4	-249.5	-417.1	23.6
Nitrogen	812	1.79	650	23.0	38200	151.6	-195.8	-370.4	77.3

Liquid helium and nitrogen are inert and do not present either an explosive or fire hazard. However, being liquefied at low temperature, care is required.

Exposure to low temperatures will cause tissue damage which is similar to, and is as serious as, burns caused by heat. In addition, the danger of asphyxiation exists in instances of the release of liquid or gas in a confined space.

Hydrogen and deuterium, when mixed with the oxygen in the air, are combustible and explosive; therefore, additional precautions must be taken when handling these two materials. The flammable range by volume of hydrogen in air is 4% to 74%; in oxygen it is 4% to 94%. The flammable range for deuterium is 5% to 75% in air.

Section III-11 details the steps that must be followed in regards to design, certification, and testing of cryogenic targets and Section III-12 does the same for Cerenkov Counters and other pressure vessels.

The following steps should be adhered to during installation and operation whenever a cryogen is to be used.

1. Work in a well ventilated space and use exhaust fans discharging to outside where possible.

2. Prior to filling a system with flammable or explosive cryogen, the system should be evacuated and then purged with an inert gas such as nitrogen.

3. Relief valves sized in conformance with prevailing ASME codes should be installed in system.

4. The system shall be positively connected to a vent system which discharges to outdoor atmosphere.

Items 5 through 8 apply to hazardous cryogens such as hydrogen and deuterium.

5. All metal parts should be solidly grounded.

6. Use of sparking materials shall be avoided whenever possible

7. No smoking is allowed in area.

8. An explosive gas detector with audible alarm shall be activated in area. This will be provided by the Experimental Area Operations Group.

9. Electrical installations in the vicinity of hydrogen and deuterium shall be intrinsically safe, and where possible, conform to National Electrical Code requirements for Class 1 - Group B, Div. 1 or 2 as outlined in the BNL Safety Manual.

The EAO and Cryogenics Groups are available for any assistance that may be desired in above areas.

SAFETY REVIEW OF LIQUID H_2 and D_2 TARGETS

All cryogenic targets, their method of installation within the operating facility and their associated safety devices must be approved for running before the EAO Watch Supervisor shall allow the target to be filled. This approval shall be accomplished by successful completion of the following safety reviews:

A. New Installations

1. Engineering Evaluation - Prior to construction, an engineering evaluation of the pertinent design and installation features shall be performed. This shall be conducted by the EP&S Division Mechanical Engineer, Design (Joe Allinger), AGS Health Physics Safety and Environmental Protection (SEP) representative (W. Robert Casey), Target Group Leader (Robert Meier), and the EP&S Liaison Engineer. It is recognized that operating conditions and experimental needs will vary considerably with the individual targets. In cases where unique conditions or exceptions to standard safety practices are requested, the EP&S Liaison Engineer shall notify, in writing, the Chairman of the Cryogenics Safety Committee. The committee will then evaluate the problem and recommend appropriate action.

2. Proof testing - When the target has been completed, it shall be tested in the Cryogenic Test Facility (Building 904). First, it shall be subjected to a Δp of 40 psi at a temperature no higher than liquid nitrogen. It then shall be filled with liquid hydrogen or liquid deuterium and maintained in a normal operating state for a minimum of eight hours.

3. Environmental Review - Upon installation of the target in the experimental area, and before filling can begin, an environmental review consisting of two parts shall take place.

   a. Part one shall be performed by the EAO Watch. This check will involve the satisfactory operation of all safety equipment and a general safety inspection. A detailed check-off list (EAO Form 1766) must be initialled, item by item, by the watch supervisor for completion of this part of the review.

   b. Part two shall be carried out by the EP&S Liaison Engineer, the SEP representative and the EAO Watch Supervisor. If this target has been referred to the Cryogenic Safety Committee, they may send representatives. This part of the inspection shall involve evaluating judgment items of a more technical nature, i.e.,

      (1) layout of personnel shielding and exit routes.
      (2) construction, size and location of hooding or enclosure.
      (3) proper operation of local fans.

(4) proper number and location of gas detector sensing heads.
(5) electrical equipment in compliance to BNL Cryogenic Safety Note 6.
(6) repeat of critical items on the check-off sheet (EAO Form 1766).

4. Certification - Upon satisfactory completion of all of the above review steps, the SEP representative shall provide a safety review sticker to be affixed to the target. He shall sign the sticker attesting to the satisfactory completion of the engineering review and the proof testing, and the Liaison Engineer shall also sign the sticker attesting to the satisfactory completion of the environmental review. (Note 1)

5. Administration

a. The Liaison Engineer shall initiate the safety review procedure. He will participate in the engineering evaluation and proof testing to the degree necessary to keep informed of conditions that would effect scheduling or operation in the experimental areas. He shall participate fully in the environmental review.

b. The SEP representative is responsible for recording the steps in (a) above for each target.

c. Copies of each entry to the safety review files shall be distributed to each individual participating in that step of the review, as well as to any others appearing on a distribution list maintained by the SEP representative.

B. Modifications to Existing Installations

1. The Liaison Engineer shall be responsible for coordinating any target modification or change in location, and for initiating the re-review of same.

2. The Liaison Engineer shall use his best judgment to determine which phase of the safety review must be repeated, and he shall have the authority to call in assistance during off-duty hours if required.

3. An off-hours review may be performed by the SEP representative and the Liaison Engineer. As many other members of the initial review group as possible shall be included. All other members must be notified of this off-hours review, together with information as to action taken, at the outset of the next working day.

4. A call down list shall be maintained in the EAO Control Room listing alternates for occasions when the SEP representative or Liaison Engineer cannot be contacted.

5. In addition to obvious modifications, the following circumstances shall also require repeat of the safety check off list as described in 3a above.

   a. A target has been removed from the experimental areas.

   b. After a major shutdown (watches broken).

   c. When a target is inactive for more than three weeks.

   d. When a target is repositioned in the experimental areas, even though not disconnected from the system.

C. Periodic Review

1. The EAO Watch shall make regular rounds to determine that standard AGS safety practices are maintained.

2. The Liaison Engineer shall make regular rounds to keep abreast of changes in operating condition or modifications.

3. Each week the EAO Watch shall test all safety equipment associated with the target that will not require its shutdown and record same in log.

4. For every 6-month period after a target has been installed, a new environmental review shall be required (Repeat A-3).

5. Any time a target is emptied for reasons other than "target empty" operations, routine warmup, techniques for impurity removal, etc., Part B of the safety check-off list Form 1766 must be filled out by the EAO Watch and signed by the Liaison Engineer. (Note 1)

D. Authority

Responsibility for all safety within the Accelerator Department rests with the Department Chairman. The authority for clearing hydrogen and deuterium targets is delegated to the EP&S Liaison Engineer and the above procedures are designed to assist him in exercising that authority.

Note 1

A more detailed description of the tagging procedure for Cryogenic targets is included in Section III-16.

SAFETY REVIEW OF ČERENKOV COUNTERS AND OTHER PRESSURE VESSELS

A. Scope

This procedure applies to all pressurized Čerenkov counters and to other types of pressure vessels that have not been built and tested to an approved safety code. Vessels containing cryogenic gases are handled as cryogenic targets in Section III-11. Compressed gas cylinders of approved commercial types are included in Section III-14.

B. Design Review

All pressure vessels shall have a preliminary design review by J. Allinger prior to testing or installation (prior to construction for new vessels). Pressure vessel designers are referred to the Safety and Environmental Protection Division Occupational Health and Safety Guide "Glass & Plastic Window Design for Pressure Vessels," latest revision.

C. Initial Installation

The Experimenter shall keep his Liaison Engineer informed of any plans concerning pressurized Čerenkov counters or other pressure vessels utilized in his experiment. The Liaison Engineer will then arrange for the handling and testing of such devices. In cases where this arrangement breaks down -

(1) The EAO rigging supervisor shall notify the EAO Watch when a pressure vessel is being moved in the AGS experimental area. (Note 1)

(2) The EAO Watch, in making their routine rounds, shall be on the lookout for untagged pressure vessels that may have entered the experimental areas without rigging assistance.

(3) The EAO Watch Supervisor shall record same and place a "Do Not Pressurize" tag on the device. (Note 1)

(4) The EAO Watch Supervisor shall then notify the appropriate Liaison Engineer who, in turn, will initiate a safety review.

D. Safety Review

(1) The size, pressure, content, or location of the device may be such as to exclude it as a hazard. This may be decided by the SEP representative in consultation with the Liaison Engineer and no review will be necessary. The SEP representative shall write a memo explaining the reason for the waiver and specifying any changes that would necessitate a review.

(2) If a review is necessary, the Liaison Engineer shall be responsible for performing the safety review. The SEP representative and the EAO Watch Supervisor shall participate in the review when available.

(3) The device shall be pressurized to 1½ times the maximum operating pressure. The test shall be hydrostatic whenever possible. When using gas as a pressuring medium for test, the device shall be tested in a safely enclosed area. Shielding blocks shall be used for the walls. The tests of all gas filled pressure vessels will be conducted by the experimenter and witnessed by the Liaison Engineer, the Duty EAO Watch Supervisor, and a representative of SEP.

(4) The device must have a safety valve of sufficient size to relieve any possible pressure buildup. The relieving orifice of the safety valve must be greater than the gas inlet orifice.

(5) The safety valve shall prevent the vessel pressure from rising more than 10% over the maximum operating pressure, and must be tested in order to insure that this criteria is met. Once an adjustable safety valve is tested, it may not be readjusted without retesting. Where possible, safety valves shall be affixed to the body of the pressure vessel or as close as practical. No valves or other restrictions shall be permitted between the safety valve and the body of the vessel. If a safety valve is changed for any reason, it must be retested.

(6) A window shield or protector shall be used if possible. If different pressure rated windows are used interchangeably on one pressure vessel, a corresponding proper safety valve shall be used for each set of windows. The windows and safety valves shall be coordinated by prominent labelling and color coding to minimize the possibility of the wrong safety valve being used with a set of windows.

(7) The position of the pressure vessel in relation to its immediate environment shall be reviewed, so that a possible failure will cause a minimum of damage.

(8) Upon completion of the above steps, a Pressure Vessel Safety Review sticker shall be placed on the device and test details sent to Safety Services Office by the Liaison Engineer and the "Do Not Pressurize" tag removed. (Note 1)

E. Re-review

A new safety review shall be undertaken in the following circumstances:

(1) Whenever a pressure vessel is removed and then returned to the experimental areas.

(2) Whenever a pressure vessel is moved within the experimental areas, a new environmental review should be made.

(3) Whenever a pressure vessel, it contents, or operating parameters are modified.

(4) Every six months.

The Liaison Engineer is responsible for scheduling and conducting the re-review.

Note 1

A more detailed description of the tagging procedure for Čerenkov counters and other pressure vessels is included in Section III-16.

PRESSURE VESSEL
SAFETY REVIEW NO. _____

REVIEWED BY _____ DATE _____

MAX. WORKING PRESSURE _____

SAFETY VALVE SETTING _____ PSIG

REMARKS: _____

NOTE: FOR INERT GAS USE ONLY.

RED ON WHITE STICKER

TAG NO._____

APPARATUS_____

DO NOT PRESSURIZE

THIS DEVICE IS NOT TO BE OPERATED
BEFORE SATISFACTORY COMPLETION
OF A SAFETY REVIEW.

BLACK ON YELLOW TAG

SAFETY REVIEW OF DEVICES CONTAINING FLAMMABLE FLUIDS

A. Scope

Previous sections outline the installation and review procedures for cryogenic targets and pressure vessels. This section covers those vessels and devices utilizing flammable gas or liquid at or near atmospheric pressure. In common use at the AGS are butane, isobutane, methylal, hydrogen and ethylene.

B. Initial Installation

The experimenter shall keep his Liaison Engineer informed of any plans concerning the use of flammable fluids in his experiment. The device shall not be moved into the experimental area until approved by the Liaison Engineer, who shall notify the EAO Watch. No fluids shall be introduced into the device until a safety review has been conducted.

C. Safety Review

1. The Liaison Engineer shall ascertain from the experimenter the type, proportional mix, volume, flow rate, pressure, and location of the fluid to be used.

2. The Liaison Engineer and the SEP Division representative may decide that the size, proportional mix, or other factor exclude the device from being considered a hazard. If so, the SEP representative shall write a memo explaining the reason for the exclusion (proportion mix precludes combustible concentration, etc.) and specifying any changes to the system that would necessitate a review.

3. If a review is necessary, the Liaison Engineer, the SEP representative, and the EAO Watch Supervisor shall review the device for safety. Their review shall include consideration of the following items:

a. The size, location and structural integrity of the device and its supports.

b. The size, material, routing and support of the fill and vent lines. All lines carrying explosive gas mixtures shall be metal tubing or piping constructed in accordance with the ANSI Code for High Pressure Piping, ANSI B1.3. Plastic tubing is acceptable for low pressure (less than 0.5 psig) systems if the lines are run in protected trays or raceways. All vent lines shall be connected to the building exhaust system or to a safe location outside of the building.

c. The advisability of using tenting and/or exhaust fans.

d. The proper type and positioning of combustible gas detectors.

e. The positioning of warning signs and/or lights.

f. The amounts and location of gas cylinder hook-up and storage (see Section III-14.)

g. The possible necessity of blast walls.

h. The proximity of electrical equipment or other potential ignition sources. A Class I, Division 2 electrical classification may be required in the area near the device.

i. The use of fencing or barriers at a distance required for lower explosive limit dispersal or ten (10) feet, whichever is the greater.

j. The establishment and marking of emergency exit routes as well as planning a recommended route for Local and Laboratory Emergency Forces to approach an emergency condition in the area.

4. The EAO Watch shall assure the satisfactory operation of all safety equipment associated with the device (detectors, fans, warning lights, etc.) and perform a general safety inspection of the area. All applicable parts of a detailed check-off list (BNL Form 1766) must be initiated by the EAO Watch for completion of this part of the review.

D. Certification

Upon satisfactory completion of the above review, the SEP representative will provide a safety review sticker to be affixed to the vessel or device. Both the Liaison Engineer and the SEP representative shall sign the sticker attesting to the satisfactory completion of the safety review. A more detailed description of the tagging procedure is included in Section III-16.

E. Re-review

If the experimenter plans any change in device components, line routing, type of gas utilized, increase in flow rate, or other change to the system, he shall notify the Liaison Engineer. The Liaison Engineer, upon determining that the change may affect the safety of personnel or equipment, will initiate another safety review.

COMPRESSED GAS CYLINDERS

The following instructions specifically refer to the use of gas cylinders at the AGS complex.

1. Compressed gas cylinders are introduced to the AGS area through BNL stores issue or directly by the experimenter. In either case, the Liaison Engineer shall be informed, in advance, of the types, estimated volumes, and uses (Cerenkov counters, proportional wire chambers, etc.) of gases to be used. The Liaison Engineer (relying upon the advice of the SEP Office where applicable) will designate the location of gas installation, flammable gas detectors, venting, spare cylinder storage, etc. as required.

2. All cylinders introduced into the AGS area shall have been tested and inspected in accordance with the latest Compressed Gas Association (CGA) and Department of Transportation (DOT) regulations within the time period allowed by those regulations (usually 5 years but there are numerous exceptions).

3. All cylinders brought into the area by experimenters shall be identified in accordance with CGA Pamphlet C-7 or DOT regulations.

4. All connectors used on compressed gas cylinders shall be in accordance with CGA Pamphlet V-1.

5. All cylinders, full or empty, shall be secured to prevent their falling or being knocked over. SEP Safety Instruction No. 8, Section VII details the methods of securing the cylinders.

6. There shall be no more than one standby cylinder inside the experimental buildings. Additional spare cylinder storage shall be in an approved outdoor location. Exceptions may be approved, in writing, by SEP to handle specific problems.

7. To prevent a fire from readily involving them, on-line and standby cylinders shall not be installed in the immediate vicinity of flammable materials.

8. Depleted gas cylinders shall be removed from the experimental area to the outdoor cylinder storage area.

9. Areas utilizing flammable and/or toxic gases shall be adequately fenced and posted with prominent warning signs at all routes of access to the area.

10. The experimenter or the Liaison Engineer shall keep the EAO Watch informed when flammable or toxic gases are in use on the experimental floor. His information should include the type, quantity, use and location of the gas. The EAO Watch, in turn, shall update the flammable gas status boards at the Experimental Control Room, Main Control Room, and the Fire Department Hold Point(s). The EAO Watch will assure that all applicable detector and alarm systems are operational.

11. If the gas use by an experimenter is expected to be secured for five (5) days or longer, all on-line and standby cylinders of flammable or toxic gases shall be disconnected and stored outdoors until the experimenter is ready to resume operations. The EAO Watch shall be notified of both the removal and return of the gas.

ELECTRICAL SAFETY

Volumes of rules and regulations exist on electrical safety and no attempt will be made to duplicate all of them here. The foundation for any safety practice is to require that only those people who have a thorough knowledge of the subject and exhibit good judgment be allowed to work with potentially dangerous equipment. The following AGS electrical procedures are presented as a guide for the experimenter.

1. All equipment brought to the AGS must be built to NEMA code specifications. The Electrical Power Services memorandum in the technical information section of this guide specifies the type of connectors approved for AGS use.

2. The experimenter shall notify his liaison engineer when electrical equipment is brought into the experimental areas so that an inspection can be arranged.

3. Competent electrical advice is available from many sources at the Accelerator Department and the experimenter should not hesitate to seek guidance through his Liaison Engineer. The experimenter's power requirements should be outlined in advance so that appropriate portable power distribution racks and tray runs can be prepared and potential problems uncovered.

4. The EAO Group will make all 208 V and 440 V connections to the building power system in the experimental areas.

5. A safety tag system is used by AGS personnel. It is absolutely forbidden that any person operate tagged devices. (See Note 1)

6. Experimental magnet power supplies and magnet transfer and reversing switches are to be entered only by approved EAO personnel. EAO personnel also do all the connecting and disconnecting of experimental magnets.

7. Electrical specifications that we have found to be of particular interest to the experimenter are as follows:

a) Any motor over 1/2 hp will be connected to 440 volt three phase power. Motors must be connected using the latest National Electrical Code standard.

b) 208 volt loads over 30 amps will not be plug-connected but will be tied in directly to building power.

c) A properly coordinated short circuit protective device must be incorporated in all experimental circuits. Ground fault protection may be required.

d) No homemade outlet boxes or extension cords will be allowed in the experimental areas. Approved extension cords can be obtained from the EAO Watch.

e) All cord-connected electrical appliances and tools must be grounded, unless specific permission is obtained from the EP&S Division for each device.

For information purposes, a copy of the Accelerator Department electrical safety practices document is attached.

Note 1

A more detailed description of the tagging procedure for electrical safety is included in Attachment C of the section and also in Section III-16.

Note 2

Section III-20 contains information on Cable Insulations.

GENERAL HIGH VOLTAGE SAFETY PRACTICES

Introduction

Many sources of high voltage exist in the apparatus installed in the Department facility. The sources may be direct or alternating current, and, from the standpoint of hazard, range from voltages below 100 volts to voltages in excess of several hundred thousand. Although an ac source of 120 volts is not considered "high voltage" more people are killed, annually, by 120 volts ac than by any other source. For purposes of these practices, however, 120 volts ac and dc voltages under 500 volts, as encountered in small chassis electronics, are excluded. When higher dc voltages at very low current capacity are present such as TV equipment, oscilloscopes, etc., properly trained and authorized personnel may work on these types of equipment. In all cases, at any voltage, live circuits must be treated as potentially dangerous and any work on any live circuit must be carefully considered and circuits should be de-energized whenever possible.

Detailed procedures will be issued describing the exact steps to be followed for working on equipment containing hazardous electrical voltages during test, calibration, maintenance or repair.

AC Circuits

Any power line circuit with 208 volts or 440 volts must be de-energized prior to any work. In the case of an emergency, and with special permission from an engineer familiar with the equipment, properly supervised work may be performed on live circuits. The presence of two men is mandatory in such cases. For distribution voltages higher than 500 volts ac, the Plant Engineering Division has full responsibility and no Accelerator Department personnel are authorized to work on such circuits except D. Davis, the Department power engineer.

Accelerator Department Safety Procedures for "Safety Tags" and "Power Room and Power Systems Safety Procedures", appended to these practices describe, in detail, the necessary procedures. Because of the high short circuit capability of our primary ac feeders, a ground wire or grounding hook must never be used on any feeder which may be energized. The resulting flash arc and fireball can cause serious injury. Ac circuits to be grounded for protective reasons must be tested first with approved devices, to ensure they are not "hot".

DC Circuits

Work with potentially dangerous dc voltages in equipment on line or in test and development must follow all the applicable procedures listed below:

1) In general lock out, tag, test and ground all equipment prior to working on it. Working on "hot" equipment is not permitted without specific approval by the engineer responsible for the equipment. The engineer must authorize all actions, procedures and precautions to be followed while working "hot" and must notify his supervisor prior to the start of any work. The provisions in the next sections must be applied in all cases.

2) Two people must be present when high voltage is exposed. These people must be familiar with the equipment and know the location of shut-off switches, crash buttons, ground sticks, etc. They must also be familiar with procedures to follow if someone suffers an electrical shock.

3) If an interlock is disabled or cheated for any reason, supervisory cognizance is required and some form of logging, tagging or sign-in required, depending on the reason for the interlock by-pass. For brief test purposes a sign is sufficient. For longer periods of operation or test, supervisory approval and logging of the by-pass is required and sufficient warning signs, lights, fences and/or personnel present is mandatory.

4) Any piece of test equipment, apparatus or probe for testing, monitoring or calibrating a high voltage device, if not wholly enclosed within the device, must be of an approved type and must be periodically tested and examined to ensure proper and safe operation.

5) Grounding sticks and hooks must be tested periodically for continuity and capability of carrying possible short circuit or capacitor discharge currents. The connection between the ground wire or strap and the hook must be exposed for visual examination and not be covered by tape or other opaque installation. If charged capacitors are present in a device, special resistor type discharge sticks (if not built into automatic shorting systems) should be provided. These special sticks must be clearly marked and all personnel must be instructed in the difference between a resistor shorting stick and a grounding stick. After discharge a normal ground stick should be applied, and left on, capacitor banks. If a built-in discharge system is used, it should operate automatically with the power source shut off and any access doors or panels opened. The discharge contact mechanism should be clearly visible upon opening the enclosure door. When the operator has ascertained that the mechanism has discharged the voltage, he shall apply the ground stick. Since the capacitor banks may contain many modules, great care must be exercised that all the modules are discharged. In addition, capacitors can recharge to dangerous voltages, requiring a ground stick during any work on a unit. In every case, however, every effort should be made to ensure that all power is off before a ground stick is applied.

6) When working on high voltage devices, items of metal jewelry should be removed, including rings, watches, belt key rings, etc.

Equipment Design

Some general guidelines for new equipment design which will improve electrical safety are:

1) An adequate level and control of light for easy visual inspection under illumination or darkness.

2) Conspicuous visual indication of both "off" and "on" conditions of each separately operable piece of hazardous equipment.

3) In case of high hazard equipment, an automatic mechanical discharging device which functions when barriers which prevent human access are broken. This device may be in plain view of the person breaking the protective barrier so that he can verify its proper functioning. Protection against the hazard of the discharge itself must be provided.

4) In the case of high power systems, a convenient discharge point with impedance capable of limiting the current to 50 amperes may be provided. A zero impedance grounding hook may first be connected to it then to one or more convenient grounding points having zero impedance where the hook will be left during the time of safe access.

5) Identification on or near all disconnects or breakers of all loads controlled by them, especially if they involve high hazard equipment.

6) Identification and location labels on all high hazard equipment of the switchgear necessary to apply and remove hazardous voltages.

7) A generally immobilizing emergency off button of switch, clearly identified, and within easy reach of all high hazard equipment. Resetting of an emergency off button must not be automatic, but require an easily understandable overt act. Also this switch may be used to initiate a call for help automatically.

8) Automatic safety interlock on all access to high hazard equipment. Any bypass of such interlock should have automatic reset.

9) Convenient, comfortable, and dry access to all equipment.

10) Emergency communication equipment should be nearby and bear clear identification of its location so that people responding to a call for help can find the site quickly.

11) Any component which, in its common use is non-hazardous, but in its actual use may be hazardous, must be distinctively colored and/or labelled. An example might be a copper pipe at high voltage.

ACCELERATOR DEPARTMENT - ELECTRICAL SAFETY
POWER ROOM AND POWER SYSTEMS
SAFETY PROCEDURES

A thorough knowledge and proper application of safety rules will help prevent accidents. Each person is expected to use common sense and good judgment in his work. In case there is any doubt as to the safe procedure involving hazards to personnel or equipment, a man must seek competent advice.

The following precautions and rules are based on experience and shall be observed. These precautions do not cover all conditions or practices which may arise. Therefore, a person must be mentally alert and careful at all times and under all conditions. Only trained men, constantly thinking of safety, will be allowed to work on high voltage, high current, or large power equipment.

1. Except in case of emergency, no work shall be performed on energized electrical equipment of 208 volts or higher.

Power feeders of 115 volts or higher shall be de-energized before any work is done on them.

2. Two men shall be present on all work on potentially active equipment rated at 208 volts or higher, or on high current equipment of any voltage.

3. Two men and an electrical power engineer in direct supervision are required for all work on equipment rated above 500 volts. (The authorized operating crews, of course are still responsible for operating their respective higher voltage power equipment).

4. The general procedure for working on electrical power equipment shall be:

a. Work only with another trained person;

b. Lock-out and tag equipment and feeder;

c. Test conductors with approved devices and then ground electrical conductors at work area;

d. Test and inspect equipment before proceeding.

5. Temporary feeders must be requested from, and approved by, the Project Power Engineer. The approval, when granted, is good only for the period of time authorized, and a new request must be filled for any extension.

6. Electrical Safety begins at the design stage. Proper electrical design will eliminate built-in hazards. Any person observing hazardous equipment, lay-out, or designs, shall report it to his supervisor. All design changes in the electrical power distribution system must be approved by the Project Power Engineer.

7. Staff members and supervisors are responsible that all working conditions in their area is safe.

8. Supervisors are responsible for the proper safety instruction of their men.

9. Requests for electrical power-shutdown on any feeder (but not branch circuit) must be checked by the coordinating engineer of the group and approved by the Project Power Engineer.

10. Except in cases of emergency tripping, all operations on circuit breakers above 480 volts must be by permission of an electrical power engineer (except as noted above for operating crews).

11. Do not wear laboratory coats, neckties, key chains, open long sleeves, or any other loose clothing around rotating machinery.

12. Put a properly coordinated short-circuit protective device in all experimental circuits.

13. Do not confuse NEC fuses, dual element fuses, current-limiting fuses, and limiters. They have different purposes and different interrupting abilities.

14. Use white tape, signs, fences, and/or flashing lights to rope off area where experimental tests using high voltages are being conducted.

15. Be very careful to keep the secondaries of all current transformers shorted, otherwise a dangerously high voltage exists across terminals.

16. Be careful of high induced voltages when opening inductive circuits.

17. In working on circuits with capacitors, be careful when unit is charged. Discharge through a resistance, then short capacitor.

18. Be sure all ground connections are securely and correctly made. On installation of new equipment, measure ground resistance to be sure connection of proper size is made securely.

19. Megger all new conductors and new equipment before applying power

BE SURE ALL EQUIPMENT IS DEAD BEFORE MEGGERING.

HI-POT ALL HIGH VOLTAGE CABLES AND EQUIPMENT.

20. Check all physical conditions such as clearances, rotations, and operation of controls before applying power to new equipment.

21. Be sure that voltmeter leads are securely fastened to binding posts on portable meters. Do nc change leads at terminals or binding posts. Do not change ammeter leads.

22. Do not open the field circuit on d-c shunt motors or do not remove the load on d-c series motors unless these machines have overspeed devices.

23. Protect ammeter and wattmeter current coils with shorting switches (or selector switches with off position) from high transient currents on starting motors or energizing transformers.

24. Be sure to use the proper tools in proper condition for the job.

25. The operators must be constantly alert to their surroundings and to the whereabouts of all other personnel in the Power Room.

26. In case of an accident in which a man is in contact with electrical power circuits, cut power by tripping out feeder breakers if possible; if not, remove man with an insulated pole. Be careful of feedback from rotating machinery.

27. Report all injuries to the Clinic immediately.

28. Report all accidents to equipment immediately to the Supervisor.

29. Do not use metal rules, metal flashlights, metal pens, key chains or wear metal jewelry, etc. around electrical circuits.

30. Cleanliness and good housekeeping are essential to safety.

ACCELERATOR DEPARTMENT - ELECTRICAL SAFETY

SAFETY TAG PROCEDURE

RED HOLD TAG

To help prevent accidents to personnel and equipment, the following system of warning tags has been adopted.

The red HOLD tags shall be used to STOP all personnel from operating the device to which the tag is attached. The red tag is used whenever the operation of the tagged device would create a condition which would endanger the life or health of any person.

Whenever a person works on a device which may be dangerous due to its use of electricity, steam, hydrogen, vacuum, etc., the controlling equipment such as switches, circuit breakers, valves, etc. shall be operated to the safe position and tagged with a red "HOLD" tag. It is the responsibility of each person working on the equipment to inspect the controlling device and tag it with his own personal tag. Whenever possible, a person shall also use his own personal padlock to lock the controlling device in the safe position. When working on equipment with another group or another person, each person actually working on the potentially hazardous equipment shall hang his own HOLD tag, or tag and padlock. No padlocks shall be used on equipment without an identifying tag.

The following rules apply to the use of red HOLD tags, and shall be observed by everyone. Failure to observe these rules will result in the severest disciplinary action.

1. No equipment may be operated, moved or changed from its red tagged position.

2. Only the person who signed a red tag may remove it.

3. The person who signed the red tag must remove it when the job or hazard is over.

The red tags will be issued by the area supervisor after investigating the request. The individually numbered tag and its stub shall be filled out completely and signed. The stub shall be returned to the area supervisor or his designate who will check, periodically, that all tags, for which stubs exist, are still active. After completion of the work, all red tags shall be returned to the area supervisor or his designate.

If it appears that a tag has been left on equipment erroneously, and the signer is absent due to sickness, vacation, or other causes, a committee of one engineer and two other qualified people, competent in the field involved, shall study the circumstances and may approve the removal of the tag.

YELLOW OPERATING TAG

The yellow operating tag is used to tag equipment which shall be left in a specified position. This tag is for the protection of equipment, processes, or operating functions. No hazard to life should be involved. Only the

authorized persons or groups listed on the yellow tag may operate the device. Only persons responsible for operation of the machine, or any of its components, shall hang yellow tags on equipment. Yellow tags are individually numbered and are issued by the area supervisor. They shall be returned to him when no longer needed. A follow-up procedure, similar to that for red tags, shall be established.

SAFETY TAGS AND STICKERS

Existing safety procedures as presented in Sections III-11, III-12, III-13 and III-15 elaborate on the safety reviews of hazardous equipment and the use of various tags and stickers. The purpose of this section is to detail the disposition of these tags and stickers and any associated procedures pertaining to safety reviews.

A. Cerenkov Counters and Other Pressure Vessels

1. Each device as it enters the experimental area is stenciled with a consecutive number. A "Do Not Pressurize" tag is attached and the appropriate notation is entered in the pressure vessel log in the Experimental Control Room.

2. After a successful safety review, an AGS Pressure Vessel Safety Review sticker is affixed. The tag is removed and turned in to the Experimental Control Room.

3. The Safety Office may also issue a sticker which will be affixed to the device and recorded in the ECR log book.

4. Any memorandum dealing with the device and comments of action taken as a result of the memorandum shall be recorded in the log book.

5. When the device is re-reviewed, new stickers are issued and the old ones returned to the Experimental Control Room.

6. When the device is taken out of service, the sticker is removed by the Liaison Engineer and the "Do Not Pressure" tag put back on. The senior watch supervisor may then destroy all the old tags and stickers. All memos and log book entries should be retained for future reference.

7. Refer to Section III-12.

B. Cryogenic Targets

1. Preoperation hold tags are not required.

2. A BNL safety review sticker will be placed on the target after the safety review.

3. The memo accompanying the sticker will be filed in the active cryogenic target log book in the Experimental Control Room. All items in the memo must be satisfied, as attested to by the watch supervisor and the Liaison Engineer, before they sign the check-off sheet giving approval to fill.

4. When a device is re-reviewed, Step 3 above is repeated.

5. When the target is taken out of service, the sticker should be removed.

6. Refer to Section III-11.

C. Devices Containing Flammable Fluids

1. No device shall be moved into the experimental area until approved by the Liaison Engineer. No fluids shall be introduced until a safety review has been conducted.

2. After a successful safety review, a sticker shall be affixed to the device.

3. Any memorandum regarding the device or procedure of operating the device shall be recorded in the ECR log book.

4. When the device is re-reviewed, new stickers shall be issued and the old stickers returned to the ECR.

5. When the device is taken out of service, the sticker is removed by the Liaison Engineer.

6. Refer to Section III-13.

D. Electrical

1. The yellow "Do Not Operate" or "Do Not Operate Without EAO Floor Watch Authorization" tags are used for operational purposes and not for safety purposes.

2. For safety purposes, the red "Hold, Danger, Do Not Operate" tag is used.

3. The numbered stub on the red tag is returned to the Experimental Control Room and placed in the electrical safety tag log book, or attached to the key pertaining to that device.

4. In all normal circumstances, only the person who signed a red "Hold Tag" may remove it. When the tag is removed by the authorized party, it is returned to the Experimental Control Room. The signer of the tag will make the appropriate entry in the log book. If the signer is absent, a committee of one engineer and two other persons, competent in the field involved, shall study the circumstances and may approve the removal of the tag. These three persons must initial the removal in the hold tag log.

5. The log book is reviewed weekly by John Sullivan, and any used tags are destroyed by him if the log book is in order.

6. See Section III-15, Attachment C for additional details.

E. Miscellaneous

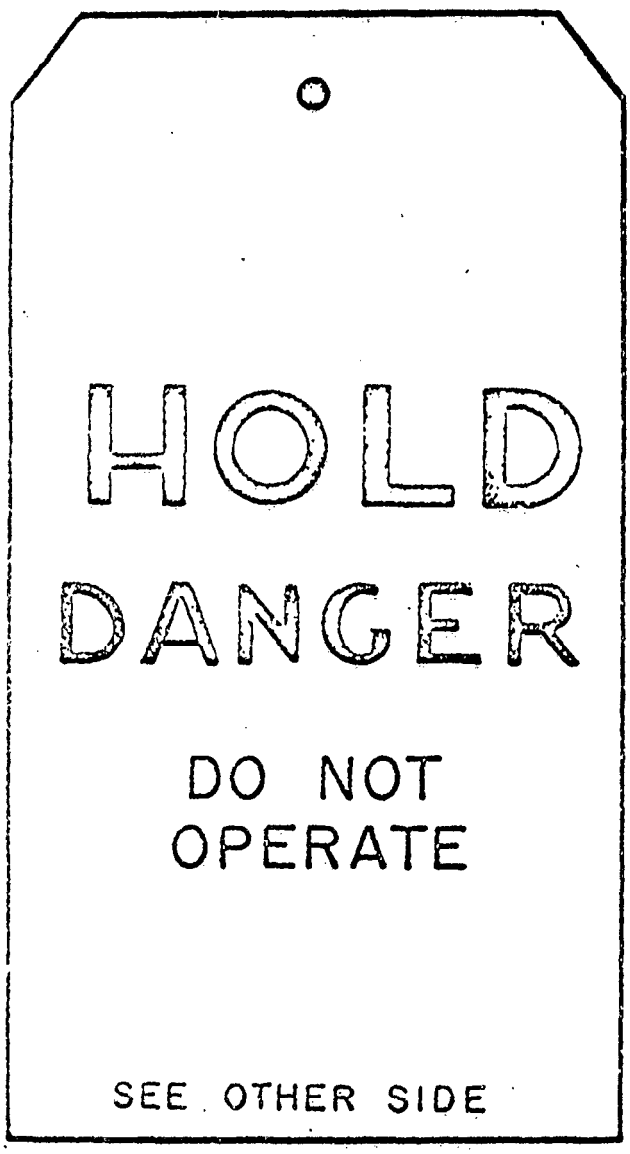
1. A yellow "Do Not Operate Without Floor Watch Authorization" tag is used to handle all other situations not covered above, but which should still remain under EAO Watch control. These are primarily temporary situations where damage to equipment rather than personnel safety could be involved.

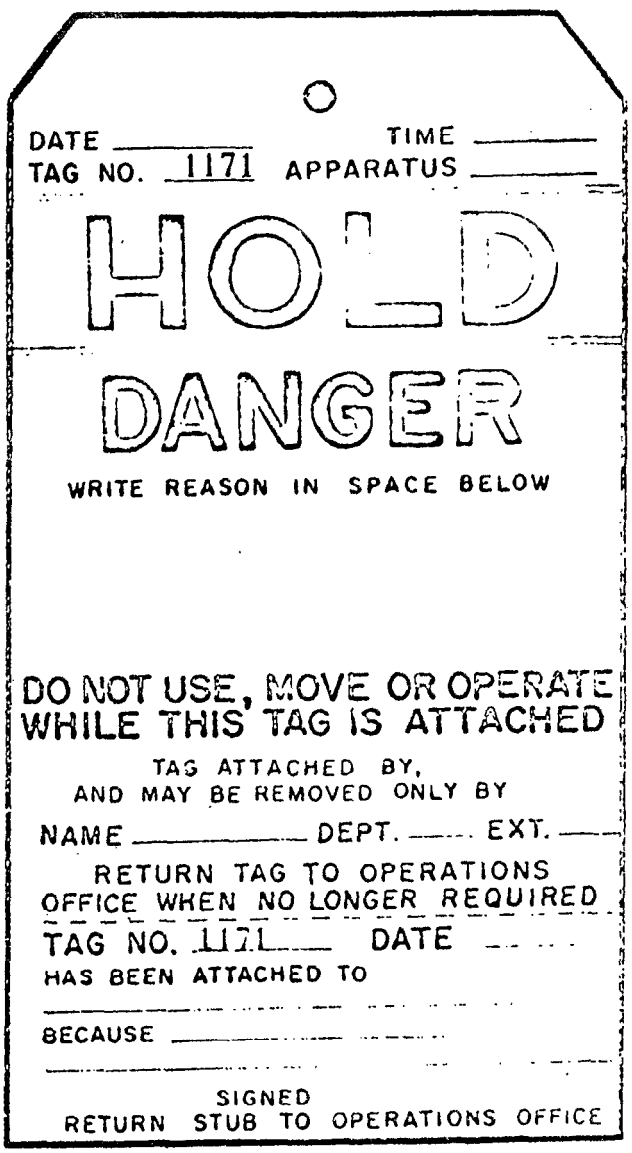
2. When the tag is issued, it shall be recorded in the EAO "Do Not Operate" tag log.

3. When the tag is removed, it should be returned to the EAO Watch supervisor who will enter the proper notation in the log book.

4. The log book will be reviewed weekly by D. Vail, and any used tags destroyed by him if the log book is in order.

Red DO NOT OPERATE Tag





(Tag color - Red)

Yellow DO NOT OPERATE Tag

AUTHORIZED OPERATORS

NAME	BNL PHONE	HOME PHONE	AUTHORIZED
1.			
2.			
3.			
4.			
5.			
6.			

TAG NO. 277 DATE _____

APPARATUS _____

DO NOT OPERATE

THIS DEVICE SHALL NOT BE OPERATED BY ANY ONE OTHER THAN THOSE DESIGNATED BY :

_____

_____

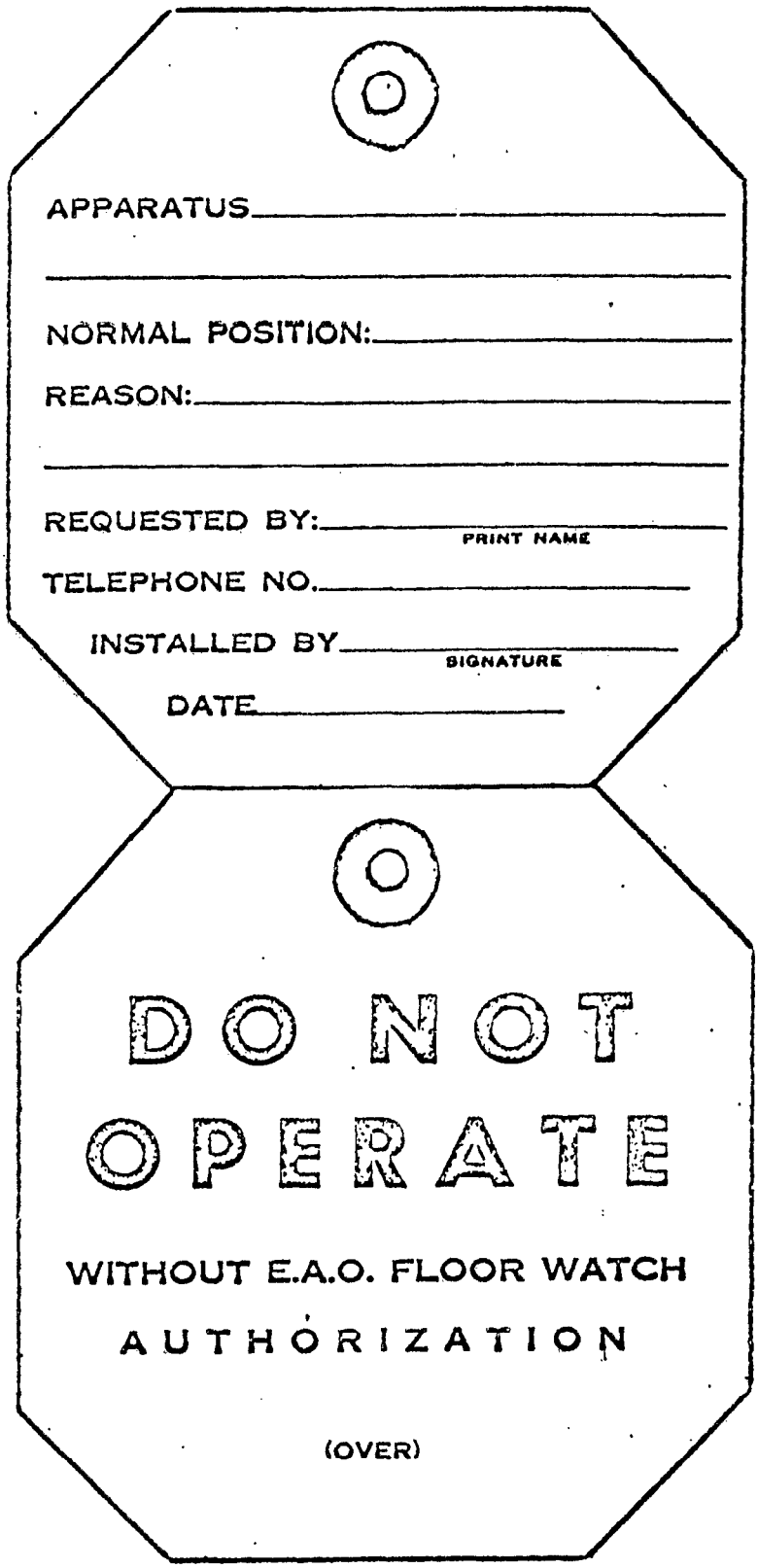
_____

(SUPERVISORS OR FOREMEN)

UNAUTHORIZED OPERATORS ARE SUBJECT TO DISCIPLINARY ACTION

(OVER)

Yellow DO NOT OPERATE Tag



(Tag color - Yellow)

LASER SAFETY

1. Scope

The use of lasers in the experimental areas is limited to alignment/measurement lasers. These are relatively low power devices with beams that can be detected in optical systems. They are usually helium-neon, continuous wave units with a beam power of about one milliwatt. The scope of this procedure is limited to these lasers. Any laser operations where more powerful beams are in use should be done in a laboratory room with proper safeguards installed. See the BNL Laser Occupational Health & Safety Guide for information on higher power lasers.

2. Hazards of Lasers with Visible Beams

The light beam emerging from almost any laser has the ability to permanently damage the retina. Because the light is coherent and is emitted from a point source, the lens of the eye is capable of focusing the beam energy on to a small area of the retina. The intense local heating can cause permanent retinal damage.

Skin damage is also a possibility for some types of lasers. For the laser beam rated at one milliwatt, skin damage is not a hazard.

3. Precautions

The specularly reflected laser beam has the same hazard as a direct beam. Every precaution should be taken to prevent accidental exposure to a direct or specularly reflected beam.

a. The laser beam should be made as inaccessible as possible; preferably, complete shielding should be provided.

b. In using the beam for tracing an optical path, the beam should be allowed to terminate on a diffuse surface such as a card or frosted glass.

c. The beam should not be viewed through magnifying optics.

d. The work area should be well lighted in order to avoid pupil dilation.

e. Before energizing a laser, examine the apparatus thoroughly to be sure that the electrical power connection is satisfactory and that there are no breaks in the housing. In the units where a beam is emitted from both ends of the housing, place a cover over the unused beam.

f. Warning signs (available from the Safety & Environmental Protection Division) should be posted around the area where a laser is being operated.

g. Under no circumstances should an activated laser be left unattended.

4. Controls

a. Every laser used at BNL is to be carried on an inventory in the Safety and Environmental Protection (SEP) Division. The operator should

notify the SEP Division before using a laser for the first time and before each new application of the laser. The SEP Division will verify the registration by placing a sticker on laser housing that carries a warning and a serial number.

b. As part of the laser registration, a person authorized by the user group will be designated to the responsible for the laser. Transfer of laser ownership or authorization should be reported to the Safety & Environmental Protection Division.

c. All laser devices should be kept in a safe storage location when not in use.

5. References

Comprehensive guides and standards that take into account spectral characteristics, laser types and lengths of exposure for safe laser operation have been issued by responsible agencies. American National Standard for the Safe Use of Lasers (ANSI Z136.1-1973) and Threshold Limit Values for Physical Agents by the American Conference of Governmental Industrial Hygienists are two such standards.

MAGNETIC FIELD HAZARDS

Many of the beam transport and spectrometer type magnets present a stray field hazard. Magnetic objects can be drawn towards the magnet gap with considerable force and may cause personnel injuries or considerable equipment damage.

In order to minimize the hazards all personnel working in the experimental areas should be aware of the following rules and procedures:

1. Pay attention to signs and warning devices indicating stray field areas. (Magnets with a small degree of hazard will be marked with warning decals. Large gap magnets will have the area of hazard defined by fences, ropes, lights, etc.)

2. Do not carry magnetic objects in the vicinity of operating magnets.

3. Do not place magnetic objects near a non-operating magnet without clearing it with the liaison engineer. Remove all tools, extra hardware, etc. from the vicinity of magnets.

4. Review any new arrangements of equipment within the defined stray field areas with the liaison engineer prior to energizing magnets.

5. Make sure that "lead" bricks are really lead. There are steel bricks, the same size and shape as the lead, throughout the experimental area.

6. Minimize the amount of work near magnets, such as drilling or filing, which creates magnetic chips. Thoroughly vacuum up the area after such work.

7. Although there are no set standards for human exposure to magnetic fields, minimize the time of body exposure in fields above 2000 gauss.

FLAMMABLE MATERIALS

The use of materials having a high degree of flammability is prohibited. In no instance should materials having an NFPA flame spread rating of 25 or more be used in the Experimental Area for construction of supports or enclosures.

1. Wood

Where wooden structures are required, fire retardant pressure impregnated wood coatings having Underwriting Laboratories listing shall be used.

2. Plastic

Polyethylene plastics shall not be used for light-tight enclosures or any other purpose. Where a flexible opaque material is required, Herculite #20 fabric shall be used as manufactured by Herculite Protective Fabric Corp., New York City.

3. Liquids

Liquids having a flash point of 140° F (60° C) or less are considered to be flammable liquids.

a. Flammable liquids in quantities of one quart or more must be kept in approved safety cans (unless in original unopened metal containers).

b. Supplies in approved flammable liquid storage rooms are not subject to (a) above.

c. When the use of safety cans (including stainless steel safety cans) has an undesirable effect on the chemical, the use of closed bottles in limited size and number may be authorized by the Department Safety Coordinator. This authorization shall be in writing with a copy to the BNL Safety & Environmental Protection Division Office.

d. Drip pans, open tanks, etc., may not be used unless protected by a self closing fusible link cover.

e. When drawing flammable liquids from bulk storage, they should be drawn either by gravity using approved type spring-closing valves, or by using a hand operated rotary-type drum transfer pump approved by Underwriters Laboratories for the liquid being dispensed. Where there is a possibility of ignition by static spark, containers shall be electrically bonded.

f. If liquid is transferred to other than the original container, the new container must be adequately labeled as to hazard.

g. The SEP Office should be consulted where questions develop in regards to the handling of flammable liquids.

CABLE INSULATIONS

Any organic insulation on wire or cable can contribute fuel to a fire. The cables and cable tray systems have often contributed to the spread of a fire, converting a minor fire into a major disaster. This has occurred in industry, at nuclear plants and at least two other major accelerator installations.

Some types of cable insulation are non-propagating, such as the neoprene jacket on all the 535 MCM power cables used in the AGS experimental areas. Others, such as polyethylene, will burn furiously and spread a fire by dripping burning pieces of material. A very common insulation material, polyvinyl chloride (PVC), when it burns, creates a large amount of hydrochloric acid as an aerosol which ruins electronic and optical equipment.

It is relatively impossible to select coaxial cables, tape cables and control cables which will not be a fire hazard. The Accelerator Department, however, attempts to minimize fire spread in cable systems by placing bags filled with vermiculite on cable trays, with appropriate spacings, to act as fire stops.

In setting up an experiment each group must consider the cable systems as an important part of the experiment. This means minimizing random cable runs on the floor and the use, wherever possible, of cable trays. The liaison engineers will assist in the set-up of the system. The Department will provide and install the vermiculite fire stops.

HAZARDOUS ITEMS REQUIRING SAFETY REVIEWS

All experimental equipment involving any of the following requires a safety review before the hazard is introduced.

1. Radiation

Generation of gamma radiation in excess of 10 mrem per hour at contact. Refer to Sections III-2 thru III-9.

2. Pressure

Over three (3) atmospheres. Refer to Sections III-11, III-12.

3. High Voltage

Over 1 kV excluding photomultiplier tubes and spark chamber pulses. Refer to Section III-15 for electrical safety procedures.

4. Flammable

(a) Any substance having a flash point less than 60° C (140° F).

(b) Any equipment supplied by the experimenter containing wood, plastic, paper, or other flammable material, in greater than trivial quantities.

Refer to Sections III-19 and III-20.

5. Toxic

(a) Any substance which has a maximum allowable concentration of less than 350 ppm.

(b) Any substance which on immediate or prolonged contact with living tissue will cause injury, including strong acids and caustics in quantities over one (1) gallon.

(c) The SEP Division should be contacted for information and advice.

6. High Temperature

Over 230° C (446° F) excluding vacuum tube filaments.

7. Radio Frequency and Microwaves

Whenever there is a possible radio frequency or microwave radiation field being generated by a source of 50 watts or more in a space that might be occupied, it is recommended that a radiation survey be made.

8. Noise

To insure the institution of proper controls to combat the effects of noise exposure, a survey should be conducted in suspect areas to determine the ambient sound levels. This may encompass the following evaluations:

(a) Hearing damage risk

(b) Speech interference

(c) Annoyance or nuisance factor

(d) Noise control engineering

If an item which will introduce any of these conditions into the experimental areas is to be used, the experimenter is obliged to notify his Liaison Engineer and inform him of the details. The Liaison Engineer in turn will contact the SEP representative, who will conduct a safety review. Recommendations resulting from the review will be directed to the Operations Group Head of the Experimental Planning and Support Division who will designate the appropriate safety measures.